

Application No. 10/646,806  
Amendment dated January 9, 2006  
Reply to Office Action of October 7, 2005

Docket No.: 20140-00263-US1  
YOR920000543US2

### **REMARKS**

#### **Status of Claims:**

Claims 20-25 are pending in the application. Each of the pending claims defines an invention that is novel and unobvious over the cited art. Favorable consideration of this case is respectfully requested.

#### **Claim Rejections Under 35 U.S.C. § 112.**

Claims 20-25 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The Examiner alleges that there is no support for the recitation "less than 0.2 microns" in claim 1.

Such a dimension is implicit in the disclosure. Paragraph [0025] and Claim 8 of the parent patent, recited a minimum thickness of the overcoat (para 0025) or stabilizing film (Claim 8) is twice the thickness of the resist image. Paragraph [0025] is currently amended to incorporate the recitation: the "thickness of said stabilizing film is from about 0.1 micron to about 5 microns". This recitation formed part of Claim 7 of the parent patent. Where the stabilizing film is 0.1 micron thick and is twice the thickness of the resist image, the image is 0.05 microns thick (height). The present invention relates to a resist image having a "high aspect ratio (height/width)". (Paragraph [0025]). Tanaka<sup>1</sup> discloses that a high aspect ratio for purposes of image collapse is at least 3/1. A 0.05 micron thick, high aspect ratio image will therefore have a feature width about 0.017 microns. Such a dimension is well within the claim limitation of "less than 0.2 microns".

#### **Claims Rejections Under 35 U.S.C. §§ 102 and 103.**

Claims 20-25 are rejected under 35 U.S.C. § 102(e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Yoon (U.S. 2002/0155379).

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Claims 20-25 are rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Part (U.S. Patent 6,369,143) or Nakano (U.S. Patent 6,287,746).

The major contention of the Office Action is that the state of the art as cited by patents 6,369,143 and 6,287,746 can achieve images as small as 0.2  $\mu\text{m}$ . Our application teaches a process to produce images smaller than 0.2  $\mu\text{m}$ . The discrepancy between the prior art and application is the understanding of the definition of resolution. Resolution as taught by the examples of the cited prior art is an isolated single trench feature in a positive resist. The present invention is directed to features of high aspect ratio equal sub micron lines and spaces or isolated lines. It is also important to note that the semiconductor devices are formed by transfer of a resist image into a semiconductor substrate. Thick resists are required because the reactive ion etch process which transfers the desired image into the silicon device can erode away 0.7  $\mu\text{m}$  of resist thickness. Thus what is defined in the resist image also bears witness to what is formed in the semiconductor device as an isolated trench, equal trenches and spaces or isolated lines.

Isolated trenches as taught by the prior art cited are not subject to image collapse because the walls are wider than the hole in the resist (the line or 0.2  $\mu\text{m}$  feature as defined in a positive resist is a trench as shown). In our application we are addressing the problem of high aspect ratio equal submicron (less than or equal to 0.2 $\mu\text{m}$  features with thickness of the resist at least 4 times the width of the trench) or an isolated submicron line. This problem is described in our application in the references of Tanaka et al.<sup>2</sup> and Mori et al.<sup>3</sup> These references describe the image collapse of resist images with aspect ratio (thickness to line width) caused by the high surface tension of water (80 dynes/cm .sup.2) rinse drying step exerting a physical force on the walls of the resist image.

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<sup>1</sup> Tanaka, T., et al., "Mechanism of Resist Pattern Collapse During Development Process," Jpn. J. Appl. Phys., vol. 32, Pt. 1, No. 12B, 1993, pp. 6059-6064. (Cited in the parent application).

<sup>2</sup> Tanaka et al., "Mechanism of Resist Pattern Collapse During Development Process", J. Appl. Physics, Vol. 32, pp. 6059-6064, 1993.

<sup>3</sup> Mori et al., "Pattern Collapse in the Top Surface Imaging Process after Dry Development," J. Vac. Sic. and Tech., Vol. B16, pp. 3477-47, 1999.

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If the problem described by Tanaka did not exist then any type of submicron image (an isolated line, isolated trench, or equal lines and spaces) in any thickness of resist could be continued to be achieved only limited by the wavelength of the exposing tool. In the prior art as cited, an aqueous base of 0.263 N tetramethylammonium hydroxide developer/ water rinse is used. The surface tension of this developer/rinse is of the order of 80 dynes/cm. Tanaka teaches that the high surface tension of a developer is directly responsible for the image collapse in submicron resist images of the equal trenches and spaces or isolated lines because of the hydrodynamic forces exerted on the walls of the resist during the removal of the developer/rinse water forcing the image to collapse. This problem is not addressed or anticipated by Park or Nakano. The patent application of Yoon does produce 0.2 to 0.3um lines and spaces but only in 0.35 um thick resist at an aspect ratio of 1.4. The Tanaka reference points out that image collapse is of concern only when the aspect ratio of the resist is  $> 3$ . The disclosure of Yoon, relating to aspect ratios of about 1.4 are therefore not relevant to the present invention. Neither Park, nor Nakato, disclose the collapse of high aspect ratio images.

**Conclusion:**

In view of the above, consideration and allowance are respectfully solicited.

Accordingly, it is respectfully requested that the foregoing amendments be entered, that the application as so amended receive an examination on the merits, and that the claims as now presented receive an early allowance.

In the event the Examiner believes an interview might serve to advance the prosecution of this application in any way, the undersigned attorney is available at the telephone number noted below.


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The Commissioner is hereby authorized to charge any fees or credit any overpayment associated with this communication, including any extension fees or fees for the net addition of claims, to Deposit Account No. 22-0185.

Dated: January 9, 2006

Respectfully submitted,

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